Cont'd C1

said X-ray mirror provides light at least having a component in wavelength ranging from 0.45 nm through 0.7 nm, and said X-ray mirror emanates said light having a peaked wavelength in a range from 0.45 nm to 0.7 nm.

REMARKS

At the time of the Office Action dated May 23, 2002, claims 1-18, 20-43 and 46-49 were pending and rejected in this application.

Claim 16 has been amended, and care has been exercised to avoid the introduction of new matter. Specifically, claim 16 has been amended to clarify that the X-ray mirror emanates light having a peaked wavelength in a range from 0.45 to 0.7 nm, which is consistent with the limitations previously presented in independent claims 1, 24, 40 and 42 and already considered by the Examiner. Applicants submit that the present Amendment does not generate any new matter issue.

<u>Claims 1-2, 4, 14-15, 24-25, 27, and 37-39 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Itabashi, JP 11-014800, in view of Bearden et al. (hereinafter Bearden)</u>

In the second enumerated paragraph of the statement of the rejection, the Examiner asserted:

> It would have been obvious, to one having ordinary skill in the art at the time the invention was made, to have the absorption edges of Bearden et al. and the peaked wavelength with the device and method of Itabashi, since these properties were well known in the art at the time the invention made as shown by Bearden et al and since obtaining the peaked wavelength or optimum value of a result effective

> variable involves only routine skill in the art. One would have been motivated to find a peaked wavelength to fine tune the laser for precise exposure methods.

Although not explicitly stated, the Examiner is apparently relying on M.P.E.P. § 2144.05 II, entitled "**OPTIMIZATION OF RANGES**" for support. This section of the M.P.E.P. cites the nearly 60 year old case of In re Aller[1] as standing for the proposition that "where the general conditions of a claim are disclosed in the prior art, it is not invention to discover the optimum or workable ranges by routine experimentation." The claimed process of In re Aller was performed at a temperature between 40°C and 80°C and an acid concentration between 25% and 70%. This process was held to be prima facie obvious over a reference process which differed from the claims only in that the reference process was performed at a temperature of 100°C and an acid concentration of 10%. As such, In re Aller involved a process in which the parameters (i.e., temperature and acid concentration) were easily varied. Furthermore, In re Aller only involved differences in concentration and temperature.

The Examiner is referred to M.P.E.P. § 2144, entitled "**Sources of Rationale Supporting a Rejection Under 35 U.S.C. 103.**" The third paragraph of M.P.E.P. § 2144 states:

> If the facts in a prior legal decision are sufficiently similar to those in an application under examination, the examiner may use the rationale used by the court. (emphasis added)

Furthermore, M.P.E.P. § 2144 goes on to state:

> If the applicant has demonstrated the criticality of a specific limitation, it would not be appropriate to rely solely on case law as the rationale to support an obvious rejection. (emphasis in original)

In contrast to In re Aller, which dealt with differences in temperature and acid concentration that could be easily manipulated, the present invention involves a material having

[1] 220 F. 2d 454, 105 USPQ 233 (CCPA 1955).

an absorption edge in a wavelength region other than 0.45 nm through 0.7 nm. As such, the parameters at issue in the present invention are completely different in kind and in their ability to be manipulated than the parameters at issue in In re Aller. As such, Applicants respectfully submit that the case law discussed in In re Aller cannot be appropriately applied to the present application.

Furthermore, the case law of In re Aller has been modified. In this regard, the Examiner is referred to M.P.E.P. § 2144.05 II(B), which is entitled "***Only Result-Effective Variables Can Be Optimized***." As recognized by the courts, the Examiner must first establish that the parameter to be modified is an art-recognized, result effective, variable. See, In re Rijckaert, 9 F.3d 1531, 28 USPQ2d 1955 (Fed. Cir. 1993); In re Yates, 663 F.2d 1054, 211 USPQ 1149 (CCPA 1981); In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). Prior to asserting that the limitations as to the parameter would have been obvious, the Examiner must first establish that the parameter is: (1) variable, (2) result effective, and (3) art-recognized.[2]

M.P.E.P. § 2144.05 II(B) cites In re Boesch[3] for support. In re Boesch involved a claim to a nickel based alloy having multiple constituents, each of the constituents having a claimed range. The claim also required that the constituents satisfy an equation as to "N_V." The applied prior art disclosed a nickel alloy having constituents that overlapped the claimed ranges of the claimed constituents. However, the equation as to N_V was not disclosed by the prior art

[2] As part (1) implies, the parameter must be variable. As such, the disclosure of a value or range does not establish that the term is variable. There must be some teaching that the limitation can vary (i.e., variable) from the taught value or range. Pertaining to part (2), the Examiner must establish that the prior art gives one having ordinary skill in the art a reason to optimize this variable (i.e., varying the limitations produces a *desirable* result). In this regard, the Examiner must go beyond establishing that varying the parameter produces some random result. A random result is not enough; instead, the result must be desirable and worth modifying to one having ordinary skill in the art. Finally, with regard to part (3), all of the above requirements must be art-recognized.

reference. The Court, however, relied upon a prior art article that suggested: "[t]he higher the N_V of a given Co-Cr-Ni alloy the higher the change for the precipitation of embrittling phases." Thus, the Court reasoned that N_V was a known result-effective variable because the prior art recognized the N_V could be varied in a certain direction to produce desired results.

The Examiner, however, has failed to establish that the prior art recognizes that a desirable result can be obtained by deviating from the disclosed range. Although the Examiner invoked the term "result effective variable" in the statement of the rejection, the Examiner merely stating that a parameter is a result effective variable does not make it true. Instead, the Examiner must establish that the parameter to be optimized must be art recognized as a result-effective variable. As the Examiner has not established that the claimed parameter is an art recognized, result-effective variable, the Examiner cannot assert that optimizing this parameter, as recited in independent claims 1 and 24, would have been obvious to one having ordinary skill in the art.

Applicants further note that in the field of X-ray proximity exposure, it had been believed, prior to time of the present invention, that exposure is optimally provided by using an X-ray having a wavelength of approximately 0.7 to 1.4 nm. Furthermore, if an X-ray having a significantly small wavelength is used for exposure, such as smaller than the above-mentioned range, the X-ray would produce a pattern having a reduced resolution. In this regard, the Examiner is referred to the documents submitted in the Information Disclosure Statement filed herewith.

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[3] 617 F.2d 272, 205 USPQ 215 (CCPA 198).

In X-ray proximity lithography, as intended in the present invention, using an X-ray of a reduced wavelength for exposure improves a resolution that is limited by Fresnel diffraction. However, when the X-ray of the reduced wavelength illuminates a resist, the X-ray radiation generates in the resist a secondary electron formed of an Auger electron and a photo-electron that has increased energy, and in proportion to approximately the 1.8 power of the energy of the generated secondary electron, a large area of the resist is photo-sensitized. This results in a blurred pattern and reduced resolution, and hence an unclear transferred pattern.

Thus, it had been believed that high resolution cannot be achieved simply by providing exposure to an X-ray having a reduced wavelength. Furthermore, with the aforementioned effect of the secondary electron taken into consideration, the X-ray's optimal wavelength falls within a range of a long wavelength. It had generally been believed before the subject application was filed that although the optimal wavelength more or less varies for different spacings between a mask and a wafer and different mask contrasts and resist processes, a wavelength range of approximately 0.7 to 1.4 nm is a suitable wavelength of an X-ray for exposure.

For example, Schattenburg (document 0) sets forth that a wavelength is selected such that: "[t]he choice is dictated by the need for reasonable absorption in the resist, reasonable transmission through the mask membrane, reasonable attenuation in an absorber, and minimal resolution degradation due to photoelectron range or diffraction" (see pg. 64, right column, line 5.) Furthermore, there are a large number of documents showing that there exists an optimal wavelength based on a limit of resolution attributed to blur caused by a secondary electron and a limit of resolution attributed to an X-ray diffraction pattern, as disclosed in: Atoda (document l),

pg. 106, Fig. 5; Deguchi (document 2), pg. 63. Fig. 1; Takigawa et al (document 3), pg. 222, Fig. 3; Okazaki (document 4); pg. 197, Fig. 2; and Suzuki et al (document 6), p. 68, Figs. 3,4. All of the figures have a horizontal axis representing wavelength and a vertical axis representing resolution and indicate that a limit resolution is provided in the form of the letter V. Thus, for a given dimension, there exists an optimal X-ray wavelength for exposure, and it had been believed that to provide enhanced resolution, a mask and a wafer must be spaced by a reduced distance and an X-ray that is used must have a wavelength shifted to be longer. There is also a document which represents resolution using a graph with a horizontal axis representing an X-ray's energy and a vertical axis representing resolution (see Khan et al (document 5), pg.3932, Fig. 2). Khan et al also thought similarly as above.

These documents describe that a specific wavelength is selected, as follows. Schattenburg (document 0) concludes that for a dimension of 0.1 micron or smaller, when a mask and a wafer can be spaced by no more than 10 microns a wavelength range from 1.0 to 1.6 nm is preferable. Atoda (document 1), sets forth that a pattern of 0.1 to 0.05 micron can be formed when a wavelength around 0.7 nm is used for exposure and a mask and a wafer are spaced by 15 to 5 microns (pg.106, line 35). Deguchi (document 2) disclosed on pg.63, Fig. 1 that exposure is provided using an X-ray set to have a wavelength of 0.7 nm and that with the range of the conventionally shortest wavelength, resolution is maximized. Takigawa et al (document 3) discloses using an X-ray having a wavelength range of 0.7 to 1.0 nm, which allows reduced attenuation at mask contrast and a beamline. Okazaki (document 4) describes on pg. 197, Fig. 2 that when exposure is provided using an X-ray having a wavelength of 1 nm and a mask and a wafer are spaced by 10 microns, a minimal dimension of 70 nm is achieved. M.

Khan (document 5) sets forth that an X-ray with energy of 1 to 2 keV is preferable for a resolution of 0.25 to 0.15 micron (see pg.3931, right column, line 8). A document (6), edited by Suzuki et al, shows a graph representing a relationship between resolution and an X-ray's wavelength (see pg. 68. Fig, 3.4). On the figure is stated that to obtain high resolution, a mask and a wafer must be spaced by a reduced distance, and an X-ray having a wavelength increased to reach around 0.9 nm must be used.

It is therefore clear that reference documents (0)-(6) all describe that no less than 0.7 nm is an optimal wavelength range for X-ray exposure. The documents further describe that providing high resolution entails spacing a mask and a wafer by a reduced distance and also providing exposure to a slightly increased wavelength. Factors other than a blurred pattern attributed to a secondary electron, as described above, that are considered in determining a wavelength for exposure are as follows:

(A) If a mask substrate is formed of a material containing Si, any X-ray having a wavelength no more than Si's K absorption edge (i.e., approximately 0.7 nm) is absorbed by the mask substrate and the X-ray illuminates a resist with reduced intensity. Furthermore the absorption of the X-ray by the mask substrate increases the temperature of the mask substrata. This results in a mask pattern being disadvantageously positionally offset.

(B) As is also apparent in Henke Database (1993), for the intended wavelength range, a resist's coefficient of X-ray absorption is proportional to approximately the third power of a wavelength used for exposure. When the X-ray's wavelength is reduced, the

resist's sensitivity to the X-ray rapidly decreases. To achieve high throughput an X-ray having a relatively long wavelength is preferably used.

(C) When a wavelength of no more than Si's absorption edge is used, the pattern of interest has its lower portion affected by a secondary electron generated from a substrate (documents 18, 19).

More specifically, Ocola et al (document 18) perform a calculation to indicate that when an X-ray having energy of 1.88 keV is used for exposure, silicon's absorption edge contributes to more second electrons discharged from a substrate (pg. 3987, Fig.3). Ogawa et al (document 19) describe that when an X-ray having a shorter wavelength than silicon's absorption edge is used to illuminate a resist, an undercut is introduced in the resist's pattern at an interface with a substrate (pg.2071, Fig. 2). Ogawa et al conclude that by removing from the X-ray a component of a wavelength shorter than silicon's absorption edge, a satisfactory pattern can be obtained (pg. 2073, right column, line 2).

Exposure facilities (IBM, NTT, Mitsubishi Denki), that are as complete as is applicable to prototyping a semiconductor device, all consider the above-mentioned factors in determining a wavelength range of an X-ray for exposure. More specifically, each of the facilities has a beamline using light for exposure with the intensity of an X-ray of no more than 0.7 nm reduced. For example, in IBM, Silverman et al (document 7) use a gold-coated grazing incidence mirror (25 mrad angle of incidence) to implement such a beamline, as described above (pg. 2977, right column, bottom line). MIT cites this beamline to analyze an optimal wavelength allowing a future resolution of 0.1 micron (document 8), and sets forth that the wavelength of the beamline

of Silverman et. al (document 7) is not optimal (pg. 2983, left column, line 10) and suggests that it should be sifted to be slightly longer (pg. 2983, left column, line 19). In other words, it suggests that as conditions for achieving the resolution of 0.1 micron, a wavelength of 1.0 nm is used and a mask and a wafer are spaced by 10 microns (p.2983, right column, line 5).

IBM's facilities of reference 7 are used not only by IBM, but also by Motorola (document (9)), Bell Laboratory and the like in a large number of device prototypes and developments as well as reviewing a limit of resolution in a range of 100 nm (pg. 2517, line 22). NTT uses the system of Kuroda et al (document 10) and that of Kaneko et al (document 11) using a platinum-coated mirror to optimize a wavelength of light for exposure (documents 10, 11). Kuroda et al study only a wavelength range of 0.7 to 1.2 nm as an effective X-ray energy range (pg. 6765, left column. line 21). Kaneko et al determine as an optimal grazing angle a grazing angle allowing maximized reflectance of a wavelength of 0.834 nm (p.3214, Fig.1). The document also describes that after it is reflected by the mirror, the X-ray's peak wavelength is 0.7 to 0.8 nm, which falls within a preferable wavelength range of 0.7 to 1.2 nm (pg.3216, left column, line 37). NTT's system described in reference 11 has been studied and developed by NTT and is allegedly applicable to prototyping a device (document 12). The ASET (document 14), participated in by Toshiba (document (13)), Hitachi, Fujitsu, NEC and the like, uses a SiC mask substrate in prototyping devices, reviewing transfer characteristics and studying other similar issues. Mitsubishi Denki also uses a platinum-coated mirror and sets a grazing angle of two degrees relative to the mirror to optimize an X-ray's wavelength (document 15). Furthermore, the company is equipped with Canon's system (document 16), which uses a beamline of a 17 mrad grazing angel SiC mirror to optimize an X-ray's wavelength (pg. 2959, Fig. 7(a)). The ASET

employs this Canon's device and uses a mask of a SiC substrate to prototype a device (document 17).

There are few cases that use X-ray exposure to achieve high resolution, and it was believed that it was difficult to apply it to the 50-nm generation and subsequent generations (document 26). It is apparent from any of Schattenburg (0), Atoda (l), Deguchi (2), Takigawa (3), Okazaki (4), M. Khan et al (5) and Suzuki (6) that it had been believed that to achieve high resolution, a mask and a wafer must be spaced by a reduced distance and a slightly longer wavelength must be used in order to provide optimal exposure. The experiments all use a mask and a wafer in close contact, and are thus, hardly a practical technique. There is, however, an example employing monochromatic radiation having a long wavelength of 1.1 nm to obtain a pattern of sub-20 nm (Simon et al (document 20). Furthermore for X-ray exposure using an MIT's point source of light, there is an example employing X-rays having wavelengths of 4.5 nm, 1.3 nm and 0.83 nm for exposure (Early et al (document 25). Thus, before the subject application was filed, it had been a generally accepted common sense in the art that obtaining a high resolution would entail using an increased wavelength for exposure. This generally accepted notion would not have motivated those skilled in the art to provide exposure to an X-ray having a wavelength reduced to no more than 0.7 nm, as claimed in the present invention.

More specifically, while it was well known that a system of Bell Laboratories positively studied in 1980s to contemplate transferring a pattern of approximately 1 μm (document (27)) employed a source of a Pd ray excited by an electron beam and having a wavelength of 0.42 nm, for systems using radiation that are aimed at 0.1 μm or less, there was no motivation to use a

reduced wavelength for exposure. Since beamlines for study have a grazing angle larger than that intended in the present invention, i.e., one degree, any systems have been reported that have the possibility that they use light for exposure including an X-ray having a wavelength of no more than 0.7 nm (China: grazing angle 20 mrad Au (document 21), Louisiana State University: grazing angle 1.5 degrees Au (document 22), Fujitsu: grazing angel 18-34 mrad Pt (document 23)). However, they all use a mirror having a reflection plane of gold or platinum. These materials have an X-ray absorption edge between 0.4 nm and 0.7 nm. As such, it is not possible, even in the beamlines for study, that an X-ray mirror emanates an X-ray with a peak wavelength in a range of 0.45 to 0.7 nm, as claimed in the present invention.

There is a description that NTT's Deguchi et al (document 24) have obtained a result from an experiment, suggesting that there is the possibility that secondary-electron blur in a resist is smaller than conventionally expected. It is believed, however, that a feature of the present invention, i.e., that an X-ray mirror emanates an X-ray with a peak wavelength in a range of 0.45 to 0.7 nm cannot be suggested. The use of a short wavelength, as disclosed in the present invention, is a technique which opens up a new possibility and there are numerous studies based thereon, such as activities (A)-(E):

> Kitayama et al (document A), the present inventors, set forth that by using the system of the present invention and a resist containing a specific element (C1, S, P, Si, Br), a resolution of 50 nm can be achieved and the resist can have a practically useful absorptance. In other words, The document suggests that conventional that conventional disadvantage (B) can be resolved.

Mizusawa et al (document B) reports an exposure system using a mirror with a grazing angle of one degree.

Khan et al (document C) set forth that exposure to an X-ray set to have energy of 2 keV allows a resolution of 50 nm and furthermore that using a resist containing silicon allows a resolution of 36 nm (document D).

Itoga et al (document E) set forth that using a resist containing a specific element (C1, S, P, Si, Br) can reduce secondary electrons generated from a substrate. That is, it suggests that conventional disadvantage (C), as described above, can be resolved.

Itabashi describes that X-ray lithography employs an X-ray having a wavelength of 0.6 nm to 0.9 nm. This range is likely determined to improve uniformity in a beamline by using a platinum mirror having an absorption edge at 0.57 nm. As such, Itabashi does not positively use exposure to an X-ray having a wavelength in a range of 0.45 to 0.7 nm. Instead, the teachings of Itabashi are based in accordance with the common sense notion generally held prior to the present invention was completed, that an X-ray having a wavelength of no less than 0.7 nm is mainly used for exposure, since when Itabashi's invention was created, there had already existed a beamline providing a main peak of 0.7 nm and a subpeak of 0.6 nm (document A), pg. 2951, Fig. 1, (Canon_MITSUBISHI beam line). Since it contemplates allowing light to illuminate an angle of view uniformly, Itabashi would have also needed to perform calculation for the subpeak of 0.6 nm. As can be seen from Bearden, simply reducing a grazing angle can increase reflectance. This, however, applies only to light on an optical axis. For a beamline for exposure, a reduced grazing angle results in a reduced acceptance angle and hence reduced intensity of light for exposure (e.g., reference 28, pg. 74, Fig. 4).

In NTT's facilities of Hosokawa et al (document 28), exposure is optimally provided by using a wavelength of 0.8 nm, a toroidal mirror, which is similar to that of IBM's facilities is used to collect light, and a glazing angle of two degrees is selected, as this allows maximized intensity of light condensed (pg. 74, Fig. 4). Afterward, Shimano et al (document 15) found that using an ellipsoidal mirror allows the glazing angle of two degrees to allow more light to be condensed, and implemented it in facilities of Mitsubishi Denki. Canon (document 16) developed not only designing techniques and mirror processing techniques but also measuring techniques, succeeded in forming a mirror to be aspherical, and first indicated that a glazing angle of one degree allows light to be condensed efficiently. Thus, implementing a mirror with a glazing angle of one degree would also not have been readily inferred. Therefore, Applicants respectfully submit that from Itabashi, it would not have been obvious to those skilled in the art to arrive at an X-ray having a peaked wavelength range of 0.45 to 0.7 nm that is positively used for exposure. Applicants, therefore, respectfully request withdrawal of the imposed rejection of claims 1-2, 4, 14-15, 24-25, 27, and 37-39 under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of Bearden.

Claims 3 and 26 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of Bearden

In the second enumerated paragraph of the statement of the rejection, the Examiner asserted that the combination of Itabashi and Bearden disclose the invention as claimed. The Examiner also stated that, as a matter of design choice, one having ordinary skill in the art would have been motivated to include a cutting mirror that absorbs at least 90% of X-rays with

wavelengths less than 0.3 nm because the general conditions of the claimed limitation is disclosed in the prior art. This rejection is respectfully traversed.

As discussed above, before the Examiner can rely on an "optimum or workable range" theory, the Examiner is first burdened to establish the claimed parameter is an art-recognized, result-effective variable. This burden, however, has not been met. The Examiner's rejection theory has no basis. Furthermore, Applicants note that claims 3 and 26 respectively depend from 1 and 24, and Applicants incorporate herein the arguments previously presented in overcoming the rejection of claims 1 and 24 under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of the Bearden.

Furthermore, as stated in the specification, for example on page 43, lines 18-22, the absorption of short-wave x-rays can advantageously prevent deterioration of resolution resulting from generation of photoelectrons in a resist. This unexpected result is neither described nor suggested by the prior art. Applicants, therefore, respectfully submit that the imposed rejection of claims 3 and 26 under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of the Bearden is not factually or legally viable and, hence, solicit withdrawal thereof.

Claims 5-8, 13, 28-31, 36, 40-43, and 46-49 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of Bearden, and further in view of Hasegawa, et al., U.S. Patent No. 6,219,400 (hereinafter Hasegawa)

In the third enumerated paragraph of the statement of the rejection, the Examiner asserted that one having ordinary skill in the art would have been motivated to modify the combination of

Itabashi and Bearden with Hasegawa to arrive at the claimed invention. This rejection is respectfully traversed.

Hasegawa discloses means for maintaining a reflection invariably by positionally controlling an X-ray mirror when a source of light positionally varies. For example, if the source of light moves in a direction, then the mirror also moves parallel to the direction. Furthermore, if the source of light emits light at a different angle, then the mirror is angled differently to maintain an angle of reflection at the mirror. Thus, as the mirror of Hasegawa is controlled, the light in a strict sense emanates along a variable optic axis and in a variable direction. However, light in Hasegawa is rendered uniform in intensity for a region radiated that is larger than that which is in effect used for exposure and its thus not disadvantageous if light emanates in such a variable direction. Therefore, Hasegawa fails to disclose that if an X-ray mirror reflects light at a variable angle, the mirror still emanates light along an invariably maintained optic axis. Accordingly, the proposed combination of references would not yield the claimed invention.

Additionally Claims 5-8, 13, 28-31 and 36 depend ultimately from independent claims 1 and 24, and Applicants incorporate herein the arguments previously advanced in traversing the imposed rejection of claims 1 and 24. Specifically, the applied prior art fails to teach or suggest an X-ray mirror emanating an X-ray having a peaked wavelength in a range from 0.45 nm to 0.7 nm. Independent claims 40 and 42 also include the same limitations; these arguments also apply to the Examiner's rejection of claims 40 and 42 and those claims dependent therefrom. Applicants, therefore, respectfully submits that the imposed rejection of claims 5-8, 13, 28-31, 36, 40-43, and 46-49 under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of

the Bearden and Hasegawa is not factually or legally viable and, hence, solicit withdrawal thereof.

Claims 9-10 and 32-33 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of Bearden

In the fourth enumerated paragraph of the statement of the rejection, the Examiner asserted that the combination of Itabashi and Bearden disclosed the invention as claimed.

Claims 9-10 and 32-33 depend ultimately from independent claims 1 and 24, and Applicants incorporate herein the arguments previously advanced in traversing the imposed rejection of claims 1 and 24. Specifically, the applied prior art fails to teach or suggest an X-ray mirror emanating an X-ray having a peaked wavelength in a range from 0.45 nm to 0.7 nm. Applicants, therefore, respectfully submit that the imposed rejection of claims 9-10 and 32-33 under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of the Bearden is not factually or legally viable and, hence, solicit withdrawal thereof.

Claims 11-12 and 34-35 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of Bearden, and further in view of Reinecke, et al., EP 903638 A1 (hereinafter Reinecke)

In the fifth enumerated paragraph of the statement of the rejection, the Examiner asserted that one having ordinary skill in the art would have been motivated to modify the combination of Itabashi and Bearden with Reinecke to arrive at the claimed invention. This rejection is respectfully traversed.

Reinecke indicates a range of 0.1 nm to 10 nm as a range in wavelength of an X-ray for exposure. However, Reinecke discloses a technique relating to LIGA (Lithographie, Galvanoformung, Abformung) used to produce a so-called micromachine. Therefore, Reinecke discloses a technique very much different from the present invention. One having ordinary skill in the art would not have been motivated to use Reinecke to modify Itabashi and Bearden. Applicants, therefore, respectfully submit that the imposed rejection of claims 11-12 and 34-35 under 35 U.S.C. § 103 for obviousness predicated upon Itabashi in view of the Bearden and Reinecke is not factually or legally viable and, hence, solicit withdrawal thereof.

Claims 16 and 17 are rejected under 35 U.S.C. § 103 for obviousness predicated upon JP 06-194497 (hereinafter Yanagihara)

In the sixth enumerated paragraph of the statement of the rejection, the Examiner asserted that one having ordinary skill in the art would have been motivated to modify Yanagihara to arrive at the claimed invention. This rejection is respectfully traversed.

In the statement of the rejection, the Examiner admitted:

> Yanagihara et al. does not seem to specifically disclose the mirror providing light at least having a component in wavelength from 0.45 nm through 0.7 nm.

The Examiner then asserted that "discovering workable ranges involves only routine skill in the art." In response, Applicants incorporate herein, as also applying to claim 16, the arguments previously presented regarding claims 1 and 24. Specifically, the Examiner has not established that this feature is an art recognized, result-effective variable such that once having ordinary skill in the art would look to optimization this feature. Furthermore, the literature

discussed above supports Applicants' contention that it would not have been obvious to those skilled in the art to arrive at an X-ray having a wavelength range of 0.45 to 0.7 nm.

The Examiner's appears to rely, in part, on "general knowledge" in semiconductor manufacturing as to the desire to make smaller patterns. In this regard, the Examiner is reminded that the factual question of motivation cannot be resolved on subjective belief of the Examiner and unknown authority, but must be based on objective evidence **of record**. In re Lee, 277 F.3d 1338 (Fed. Cir. 2002). Furthermore, the requisite motivation to support the ultimate legal conclusion of obviousness under 35 U.S.C. § 103 requires not only a suggestion but a reasonable expectation of success. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Obvious to try is not the standard. In re O'Farrell, 853 F.2d 894, 7 USPQ2d 1673 (Fed. Cir. 1988); In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Dow Chemical Co., 837 F.2d 469, 5 USPQ2d 1529 (Fed. Cir. 1988). Notwithstanding that there may be some general desire to reduce pattern size, the Examiner must establish a reasonable expectation of success in accomplishing this goal. The literature discussed indicates that there was not a reasonable expectation of success in achieving Applicants' claimed invention.

The Examiner also stated:

> the recitation with respect to the manner, which a claimed apparatus is intended to be employed, does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. In this case, the claim is only drawn to the mirror. It does not matter how the mirror [sic]. The claim is only for the actual mirror itself.

This logic, however, is flawed. The Examiner is assuming that the mirror disclosed by Yanagihara meets the claimed structural limitations, but this assumption is incorrect. As an example, consider a claim directed to a glass that allows a certain wavelength of light to pass

through glass (i.e., a red tinted glass). By stating that the glass emits a certain wavelength of glass, the glass is structurally limited. For example, a blue tinted glass would not be capable of allowing the claimed wavelength of light to pass through. Therefore, by requiring that the X-ray mirror emanates light having a peaked wavelength in range from 0.45 to 0.7 nm, claim 16 structurally limits the X-ray mirror being claimed. Thus, the Examiner is not free to ignore this limitation. Applicants, therefore, respectfully submits that the imposed rejection of claims 16 and 17 under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara is not viable and, hence, solicit withdrawal thereof.

Claim 18 is rejected under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara in view of Itabashi

In the seventh enumerated paragraph of the statement of the rejection, the Examiner asserted that the combination of Yanagihara in view of Itabashi disclose the invention as claimed. This rejection is respectfully traversed.

Claim 18 depends ultimately from independent claim 16 and Applicants incorporate herein the arguments previously advanced in traversing the imposed rejection of claim 16. Specifically, Yanagihara fails to teach or suggest an X-ray mirror emanating an X-ray having a peaked wavelength in a range from 0.45 nm to 0.7 nm. The secondary reference to Itabashi also does not disclose this feature. Applicants, therefore, respectfully submit that the imposed rejection of claim 18 under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara in view of Itabashi is not viable and, hence, solicit withdrawal thereof.

Claims 20 and 21 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara in view of Itabashi and further in view of Hasegawa

In the eighth enumerated paragraph of the statement of the rejection, the Examiner asserted that the combination of Yanagihara in view of Itabashi and Hasegawa disclose the invention as claimed. This rejection is respectfully traversed.

Claims 20 and 21 depend ultimately from independent claim 16 and Applicants incorporate herein the arguments previously advanced in traversing the imposed rejection of claim 16. Specifically, Yanagihara fails to teach or suggest an X-ray mirror emanating an X-ray having a peaked wavelength in a range from 0.45 nm to 0.7 nm. The secondary references to Itabashi and Hasegawa also do not disclose this feature. Applicants, therefore, respectfully submit that the imposed rejection of claim 20 and 21 under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara in view of Itabashi and Hasegawa is not viable and, hence, solicit withdrawal thereof.

Claims 22 and 23 are rejected under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara

In the ninth enumerated paragraph of the statement of the rejection, the Examiner asserted that one having ordinary skill in the art would have been motivated to modify Yanagihara to arrive at the claimed invention. This rejection is respectfully traversed.

Claims 22 and 23 depend ultimately from independent claim 16 and Applicants incorporate herein the arguments previously advanced in traversing the imposed rejection of claim 16. Specifically, Yanagihara fails to teach or suggest an X-ray mirror emanating an X-ray having a

peaked wavelength in a range from 0.45 nm to 0.7 nm. Applicants, therefore, respectfully submit that the imposed rejection of claim 22 and 23 under 35 U.S.C. § 103 for obviousness predicated upon Yanagihara is not viable and, hence, solicit withdrawal thereof.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Applicants have made every effort to present claims which distinguish over the prior art, and it is believed that all claims are in condition for allowance. However, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic interview would expedite the prosecution of the application to an allowance. Accordingly, and in view of the foregoing remarks, Applicants hereby respectfully request reconsideration and prompt allowance of the pending claims.

To the extent necessary, a petition for an extension of time under 37 C.F.R. § 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417, and please credit any excess fees to such deposit account.

Respectfully submitted,

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Version with markings to show changes made

IN THE CLAIMS:

16. (Thrice Amended) An X-ray mirror containing one type of material for a mirror selected from the group consisting of titanium, silver, and nitride thereof, a carbide thereof, a boride thereof, diamond, diamond-like carbon, and boron nitride, and wherein

said X-ray mirror provides light at least having a component in wavelength ranging from 0.45nm through 0.7 nm, and said X-ray mirror emanates said light having a peaked wavelength in a range from 0.45 nm to 0.7 nm.